Not so Mr. Conrady, who contributes to the present volume a couple of chapters on the undulatory theory of light, and on Abbe's diffraction theory of the microscope image. Mr. Conrady "has no use" for the new theory, propounded long since by Dr. Altmann, and only of value in that it called forth a complete and overwhelming reply from Abbe in his well-known paper "Uber die Grenzen der geometrischen Optik." He urges strongly the adequacy of the diffraction theory to explain all the observed phenomena, and is emphatic as to the inapplicability to the microscope of the theory of the Airy diffusion-disc.

This, however, is not the place to enter on this much-discussed but fascinating topic, with which, indeed, Mr. Spitta's book, from its plan and object, is but little concerned. It is the practical rather than the theoretical to which attention is directed, to the intelligent handling of one of the most finished and delicate of optical instruments.

From this point of view, let us hasten to urge every student of the microscope who wishes to gain a thorough understanding of its principles and possibilities and its defects, and every user of the instrument who desires a work of reference to which he may turn for an explanation of some unexplained optical phenomenon, or for particulars of up-to-date apparatus, to procure a copy of Mr. Spitta's book without delay. It is a leisurely book—an unfriendly critic might even call it diffuse—but there is scarcely a chapter which will not repay careful reading; and when one comes to the chapter on "Testing Objectives," one can but feel grateful to Mr. Spitta for his admirable treatment of a difficult subject.

Mr. Spitta has called his work "Microscopy"; but it is only of one branch of microscopy that he treats. His subject is the theory and use of the microscope as an optical instrument; with the preparation of objects for the microscope he does not deal. The book will be of much interest and of great value to many who are in no sense "microscopists," but who use the microscope as an accessory in other physical investigation. The non-mathematician who desires to know the meaning of the terms "numerical aperture," the "sine-law," "resolving power," or to make himself familiar with the essentials of the Abbe theory, will find Mr. Spitta a satisfactory guide; and the microscopist proper will find innumerable useful suggestions as to the manipulation of his instrument.

It will be well to indicate shortly the ground Mr. Spitta covers. After a preliminary account of the elements of geometrical optics and the theory of the simple microscope, he proceeds to deal with the compound microscope in its modern form, fine adjustments, mechanical stage, substage, objectives—achromatic, semi-apochromatic, and apochromatic; dry and immersion—with details and illustrations of the work of the best makers. In connection with objectives the chief optical properties, spherical and chromatic aberration, the sine-law, &c., are discussed. Then follow chapters on numerical aperture, eyepieces, magnification—in which may be found the main principles of the Abbe theory—the substage condenser, and methods of illumination—critical light, monochromatic light, dark ground illumination, Rheinberg's multiple colour illumination, oblique light, illumination of opaque objects, polarised light. Then we come to "the use of the microscope," with which may be mentioned the valuable hints to workers with which the volume concludes. The binocular microscope and measurements with the microscope are treated, and a long chapter is devoted to the discussion and illustration of microscopes by different makers for various purposes, which is a feature of the book.

Then follows the excellent account of the testing of objectives already referred to. Mr. Spitta confines himself to the use of the Abbe test-plate, and of specified test objects, but within these limits he goes into the matter in detail and with admirable clearness, and this chapter alone is sufficient to justify the work. The section is illustrated in sixteen plates by a beautiful series of photomicrographs. Mr. Conrady's two chapters follow, with another on accessory apparatus. The usefulness of the book is completed by a satisfactory index.

We have said enough to commend Mr. Spitta's volume. It teems with "tips," and is likely to command an even wider popularity than his previous books on allied subjects.

MATHEMATICAL TEXT-BOOKS.

(1) *Easy Exercises in Algebra for Beginners.* By W. S. Beard. Pp. x+134. (London: Methuen and Co., n.d.) Price 1*s.* 9*d.*

(2) *Plane Geometry for Secondary Schools.* By C. Davison and C. H. Richards. Pp. viii+411. (Cambridge: University Press, 1907.) Price 4*s.*

(3) *Cartesian Plane Geometry.* Part i. By Charlotte A. Scott. Pp. xiv+428. (London: J. M. Dent and Co., 1907.) Price 5*s.*

(4) *A Sequel to Elementary Geometry.* By J. W. Russell. Pp. viii+204. (Oxford: Clarendon Press, 1907.) Price 6*s.*

(5) *Text-book of Mechanics.* Vol. ii. By L. A. Martin, Jun. Pp. xiv+214. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 6*s.* 6*d.* net.

(6) *Elementary Statics.* By W. P. Borchardt. Pp. viii+398+xx. (London: Rivingtons, 1907.) Price 4*s.* 6*d.*

(7) *Elementary Trigonometry.* With Answers. By C. Hawkins. Pp. xiii+310. (London: J. M. Dent and Co., 1907.) Price 4*s.* 6*d.*

(1) THIS book is a collection of 3500 examples in elementary algebra up to quadratic equations. It will prove useful to those teachers who dictate the bookwork instead of leaving their pupils to read it for themselves. The exercises are well arranged, and there is a good list of contents, so that the reader can at a moment's notice find a dozen or more examples of exactly the type he requires for class use. Answers and examination papers are given, and even though the book does suggest cramming, it has a practical value which will ensure it a welcome. The idea might with advantage be extended to other mathematical subjects.

(2) This book is written for schoolboys who have had a preliminary training in practical geometry, and is devoted almost entirely to theoretical work. The authors are not very fortunate in the first few pages, but when once the reader is fairly started, he will find very little to which he can take exception, provided he is in sympathy with the general arrangement of the book. The authors adopt a conservative point of view, and give a very strong Euclidean flavour to their treatise, but they show themselves capable of appreciating the chief lessons to be learnt from recent experiments in geometrical teaching. Hypothetical constructions are allowed if it can be proved that the construction is possible. The theory of parallels based on Playfair's axiom is deferred until after the principal properties of congruent triangles have been proved. The book covers the substance of Euclid i. to vi.; those of Euclid's theorems which are not included in the text are set as riders together with a large number of well-chosen examples. The treatise is very complete within the limits chosen, and contains sections on loci, geometrical dissections, the nine-point circle, inscribed and escribed circles, Ceva's theorems, &c. A teacher who has conservative views could, on the whole, hardly wish for a better text-book.

(3) The treatise on analytical conics in this series was undertaken by Mr. R. W. H. T. Hudson, and Miss Scott, while pursuing her own plan, has had at her disposal the outline he drew up before his death. The book will prove interesting to the teacher on account of the extreme novelty of the arrangement. The author claims to have shown deference to existing conventions, but it is not so easy to see where self-restraint has been exercised. Apart from the professed innovation of introducing line-coordinates concurrently with point-coordinates from the very first, we have the novelty that the circle is taken as a special case of the ellipse, change of axes is deferred until necessary for the tracing of conics, and so on.

The chief fault of the treatise is probably that the arrangement is far too confused. Properties of the circle are spread over three or four chapters in various parts of the book, interspersed with theorems on conics and straight lines, which theorems are in their turn introduced apparently incidentally, then recapitulated further on, only to be extended in a still later chapter. It seems very doubtful whether a pupil brought up on this method would be able in any way to systematise his knowledge.

Introductory remarks and definitions are apt to be a little obscure, but this is amply compensated by excellent diagrams and very intelligible examples worked at full length. It is a pity that no answers to the exercises are given.

(4) This book is somewhat on the lines of Casey's sequel to Euclid, and covers a good deal of the same ground. It is in many ways an improvement on that standard treatise, and will probably replace it with those students who are just beginning an honours course in mathematics. The chief criticism we have to make is that the contents are of too miscellaneous a character; no one subject is treated quite fully enough, and the reader is led from one idea to another with almost bewildering rapidity. Perhaps some improvement might have been effected by omitting the chapter on "recent geometry," which contains very little that is new except the nomenclature, and treating more important subjects at greater length.

In a book of this kind the chief danger lies in the insertion of artificial geometrical proofs of theorems best established by analytical or other methods. The author is to be congratulated in having avoided this danger, on the whole, with marked success, though perhaps it would be better to solve Fermat's problem and other examples in chapter xi. by the more instructive methods of chapter xii. The reasoning adopted is of a simple character, and in many cases alternative proofs of equal elegance and simplicity are given. There is a plentiful supply of well-chosen exercises; in many cases concise but useful hints are given in the text for their solution, and a key to the remainder of the examples is promised. The book will prove very inspiring to the beginner, and give pleasure to the more advanced reader.

(5) Mr. Martin's book is intended for readers who have a fair knowledge of differential calculus and are beginning integral, and it covers the more elementary portions of uniplanar dynamics of the particle and rigid body. There is room for such a treatise, but the present one is not entirely satisfactory. Much of it is carelessly worded, *e.g.* a movement is called the motion of a "point" and of a "particle" in the same section, the definition of a radian is unintelligible, &c. Some of the proofs, as in the case of normal acceleration, are far too cumbrous, while others are hardly rigid—an instance of this is the absence of any mention of D'Alembert's principle or a substitute therefor. The 420 examples will be useful, though no answers are given.

(6) In this treatise an attempt is made to cover the ground very thoroughly; for instance, three distinct proofs are given of the resultant of two parallel forces and the three requisites of a good balance are discussed, while chapters on work and energy, frameworks, virtual work, elasticity, &c., are given. The object aimed at is to include all that part of statics which can be profitably discussed without the use of the calculus. The result is a book which every teacher should possess; it contains all the bookwork he is likely to want and more, while it is a most useful mine of excellent examples. It is more doubtful whether the book is equally suited to class use; it is hardly simple enough for beginners, and the practical experiments are not described in sufficient detail to be of much use for such a purpose. Readers who have Borchardt and Perrott's "Trigonometry" will have a very fair idea of the style and aim of this "Statics."

(7) Mr. Hawkins's book is rather attractive; for a boy who was learning trigonometry in order to become a surveyor it would be ideal. It may be doubted, however, whether the ordinary pupil will take much interest in so many technical details of land-measurement, even granting that practical applications have a fascination for beginners. With a

little judicious skipping, however, the book may be suited to ordinary class use. It is well written, very intelligible, pleasant reading, and mathematically sound (except in § 88). An interesting feature is that the use of the sine and cosecant in solving triangles, finding areas, &c., is explained before the definition of the cosine and secant, and similarly the applications of the cosine are given before the tangent and cotangent are introduced. The contents of chapters ix. and x., with the exception of an isolated section on inscribed and escribed circles, might well be left to a more advanced treatise. The diagrams throughout are excellent. Demoivre's theorem and similar theoretical developments are not included.

OUR BOOK SHELF.

(1) *Mining Tables.* By Dr. F. H. Hatch and E. J. Vallentine. Pp. viii+200. (London: Macmillan and Co., Ltd., 1907.) Price 6*s.* net.

(2) *The Weights and Measures of International Commerce.* Tables and Equivalents. Pp. 59. (London: Macmillan and Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

In the former of these works the authors give a comparison of the units of weight, measure, currency, and mining area of different countries, together with tables, constants, and other data useful to mining engineers and surveyors. In the second work, they reprint a selection of tables that appeal to others besides mining engineers. On the whole, the authors have carried out their difficult task in an admirable manner. It is customary for engineers to get together data for use in their professional work, and the reprint of the authors' collection cannot fail to be of service to other workers in the same field. All such collections have, however, their limitations, as the requirements of no two engineers are precisely the same. We miss, for example, information relating to the strength of materials, tables for converting kilograms per square millimetre into tons per square inch, and the like, and in the table of rates of exchange for money, any reference to Spain, Portugal, or the South American republics.

While it is easy to point to omissions, we have not been able to detect any errors in the figures given, notwithstanding a careful comparison, for example, of the tables for the calculation of heights and distances from tacheometer readings with the similar tables communicated by Mr. Neil Kennedy to the Institution of Civil Engineers in 1890. In the text, typographical errors are few. There is a little want of uniformity in the spelling of the names of metric weights and measures, grammes and grams, metre and meter, litre and liter being used indiscriminately. Barbados is spelt incorrectly; and Mohs, the inventor of the scale of hardness, appears as Moh. On the title-page, too, Dr. Hatch describes himself as member of the Institute, instead of Institution, of Civil Engineers, and Mr. Vallentine as member of the Federated Institute of Mining Engineers, a society which dropped the term Federated in 1897, and has since been known as the Institution of Mining Engineers.

Les Aciers spéciaux. By L. Revillon. Encyclopédie scientifique des Aides Memoires. Pp. 188. (Paris: Gauthier-Villars, n.d.) Price 2.50 francs.

To understand even the present state of general knowledge with regard to special steels a very large and difficult field must be traversed, and the task of condensation to a reasonable limit will be a heavy one, but, for those who are unable from various causes to enter the field and would like to know the kind of work that is being done, this book may be helpful. To compare the results given with one's own ascertained tests of materials made under known conditions would be a considerable task, but a few general matters taken at random are worth noting as examples.

On p. 99 we are told that chrome steels are chiefly made in the crucible, even when large pieces, &c. What can the author think would prevent them being made in the open hearth? They are so made in large quantities. On p. 154, the author permits himself to dream that nickel chrome steels may also be made in the open hearth (they are made extensively) as nickel steels and chrome steels are (which seems to contradict p. 99). P. 118, "Vanadium remains a scientific curiosity . . . excepting for steels of high price such as tool steels." It was a source of great pride to the late Auguste Wiener that he had obtained the recognition of vanadium as an element of practical industrial importance in the manufacture of special structural steels, and Kent-Smith's success in making vanadium chrome and vanadium nickel steels was the main reason why he was taken to America, undoubtedly to carry on similar work.

One regrets to find in a work on this subject, where names are freely used, that the only mention of Prof. Arnold, who has done so much in connection with nickel, vanadium, and chrome steels, is in chapter xv., on nickel vanadium steels:—"There exist also several tests by Prof. Arnold." Perhaps there is some kind of poetic justice in the fact that, to take one example only, the author's readers will not know that a nickel steel given by him at 61 tons per square inch, with an elongation of 3·5 per cent. on 100 mm., when properly made, gives the extraordinary test of about 90 tons per square inch and 10 per cent. elongation on 2″.

A. McW.

Voice Training in Speech and Song. By H. H. Hulbert. Pp. xii+83. (London: W. B. Clive, 1907.) Price 1*s.* 6*d.*

This book is primarily designed for the use of teachers, who, as the author points out, are probably the greatest voice-users, but it will interest all who speak or sing in public. Voice production is difficult to teach even when the pupil has the advantage of performing exercises under the personal supervision of the instructor, and it may be doubted if much improvement in the use of the organs of speech can be effected by reading text-books alone; but what is possible in the direction of describing suitable exercises appears to have been accomplished with success by the author. The book provides an account of the structure and use of the vocal organs, and the means of securing distinct articulation; it should be useful to all persons who are attending practical classes for the cultivation of the voice.

Revisio Conocephalidarum. By H. Karny. Pp. 114. (Jena: Gustav Fischer, 1907.) Price 4.50 marks.

This compilation dealing with a subfamily of the Locustidæ, was published in the Abhandlungen der k.k. zoologisch-botanischen Gesellschaft of Vienna, and provides a serviceable continuation of the monograph prepared by Redtenbacher that appeared in the Behandlungen of the same society in 1891. Revised analytical tables are given for several of the genera to include recent determinations by the author and other workers. Three genera are here described for the first time—Paroxyprora, Rhytidogyne, and Pœcilomerus. A considerable number of new species are made, principally additions to the tribe of Conocephalini; many were collected in South America, and six were obtained in New Guinea.